An Explanation Method of Unfamiliar Tourist Spots based on Roles of User's Familiar Spots

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***Abstract*—In recent years, when planning tourist spots, planning is often made by utilizing tourist information on the Web. However, after deciding the area you want to visit from many areas, the user also needs enormous amount of time and effort to find tourist spots that match your image. In addition, there are cases where the user feels expectation and anxiety with respect to the unfamiliar spot. In this research, in order to support understanding of users' unknown spots, we propose explanatory method that supports the understanding by fitting the features of tourist spots that have familiar spots to unfamiliar spots. In order to emphasize the features of the tourist spots themselves, extraction of features of each tourist spot is done by work using all reviews of tourist spots entered by the user, all reviews of tourist spots in the target area. We also conduct an evaluation experiment to construct the prototype system and verify the effect of the explanatory information between the familiar spot and the unfamiliar spot.**

***Index Terms*—tourist spots, understanding support, reviews, harmonic mean, paragraph vector**

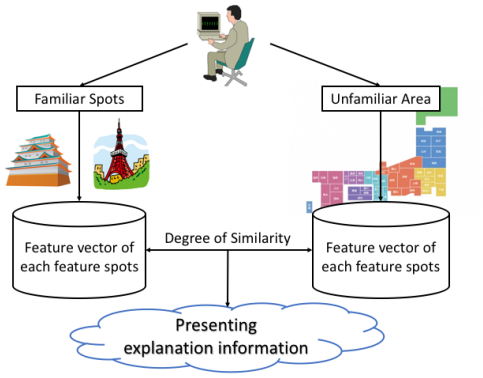

Fig. 1. An explanation method of unfamiliar tourist spots based on roles of user's familiar spots

I. Introduction

WHEN deciding the travel destination, the traveler selects tourist spots by planning a travel plan, watching tourist spots search sites and books related to tourist information. However, after deciding the area you want to visit from many areas,and further from their many tourist spots in the area is not easy to find. In the case where the tourist spots desired to go are not decided, it is considered that it is more likely to decide tourist spots by looking at ranking and recommendation information. At this time, the image for the tourist spots selected by the user becomes ambiguous, which may cause anxiety.

In recent years, the speed of development of tourism industry and social networking service is accelerating, and the number of users who post reviews on tourist spots experienced to the tourist spot search site is increasing. In order to effectively understand various tourist spots, it is essential to consider the correspondence between unknown information and existing information based on existing information. This way of thinking is equivalent to analogy which applies to the things by previous experiences (called the base), or problems (called the target). For example, whereas unknown spots such as "Kanazawa's Nisityayagai", if you explain that it is similar to the already visited "Kyoto Hanamikoj", it may make it easier to understand the image.

In this research, in order to support understanding of users' unfamiliar spots, we propose explanatory method that supports the understanding by fitting the features of tourist spots that have familiar spots to unfamiliar spots. Specifically, from the familiar spots and the unfamiliar area entered by the user, we use the review to extract the unique features of each spot in the familiar spots and the unique features of each spot in the unfamiliar area, compare and present explanatory information. With this prototype system, users aim to support understanding of unfamiliar spots. Fig. 1 is a conceptual diagram of the proposed method.

The structure of this paper is as follows. Section II describes related research. Section III gives an overview of the proposed method. Section IV describes evaluation experiments and considerations to verify the effect of the constructed prototype system. Section V describes with conclusions and future work.

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II. Related Work

A. Research using user history

Many researches on retrieval and recommendation system using the user's experience history have been published. Kurashima et al.[1] proposed a travel route recommendation method using geotag information of photos posted to Flickr as a travel history of people. In this method, it is assumed that it is easy to move from a user's present location to a place easily accessible to the user's interest, and a behavior model is generated. That geotagged photo aggregation of users can be regarded as personal travel history when sorted by time information, and we generate user behavior model using geotag information. Kitamura et al.[2] proposed a method of recommending sightseeing spots based on estimating user's preferences of travel plan from past personal travel photographs using general object recognition. Using an object recognition system to acquire keywords of subject information taken in the photos and represented the co-occurrence of the keywords by a graph visualization technique. In addition, present a user interface that visualizes a graph with travel

photos based on our graph visualization technique. Cheng et al.[3] used photographs of freely available community contributions to focus on personalized trip recommendations, considering specific user profiles or attributes, suggested to consider personalized travel recommendations.

B. Research on analogy

Analogies were pointed out as contributing to creative thinking[4]. Analogical thinking works when acquiring a concept (called the target) from known knowledge (called the bases)[5]. Many of the researches on analogy are given the base learning data and targeted problems, and the problems are solved by mapping the features of things to the feature of the problem[6]. Gick et al. designed to investigate the use of analogies between disparate domains as a guide to finding solutions for an ill-defined problem. Some studied about how to give learning data and functions[7], and clarified whether to solve the problem depending on the degree of cognitive proficiency[8]. In many of the conventional research including these, after giving bases and targets for analogy, we solve problems according to a certain procedure. There are three types of structural similarities"similarity of object level" determined by the number of shared features, "relationship similarity" based on the degree of sharedness of relationships existing in the base and the relationship existing in the base, and similarity in the title solution or target level There is a certain "pragmatic similarity"[5], [9].

In the conventional method of using the user's experience history, many researches that analyze the geotag information of the history photograph and make it user's preference are performed. In addition, it is well used in learning support on analogy technology. In this research, using the review of familiar spots and unfamiliar spots, the relative features of each spot in each set of user familiar spot set and unfamiliar spot set are determined and associated, thereby supporting understanding of spots explanation information can be presented. Moreover, because the quality of analogy is treated explicitly, it is considered to be similar to the similarity of structure "similarity of relationship level" by this research.

III. An Explanation Method of Unfamiliar Tourist Spots

We propose an explanation method of unfamiliar tourist spots based on roles of user's familiar spots Specifically, first, the user inputs a plurality of tourist spots that have been visited and tourist spot area information that user wishes to visit. Use the familiar spot review vector to find the feature vector for each familiar spot. Similarly, the feature vector of each spot in the area is obtained for an unfamiliar spot. Next, we associate familiar spots with features similar to the difference features between the familiar spot review vector and the unfamiliar spot review vector. Finally, explanation method for supporting understanding of unfamiliar spot is defined using TFIDF and presented to the user.

A. Generating feature vector from reviews of spot

Review vectors of familiar spots and unfamiliar spots are created using a discriminated (original) review with the morphological analyzer[10] "mecab-ipadic-NEologd"[1]. After that, using Distributed[2] Bag-of-Words of Doc2Vec, we use a vector created in 300 dimensions using all reviews of each spot. In this paper, we will use the review data obtained from "Jalan"[3] until the end of September 2016.

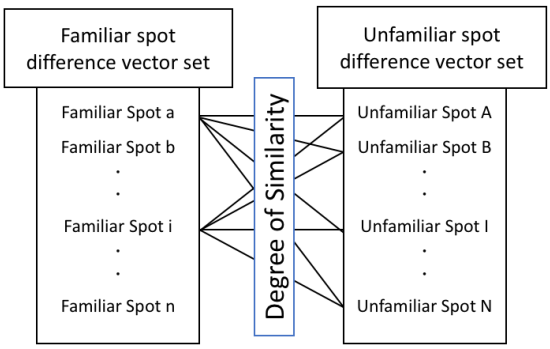

Fig. 2. Concept of similarity calculation

B. Relative features for role of tourist spots

In this research, features of tourist spots make use of relative features. The relative feature is a unique feature when a specific tourist spot is compared with other tourist spots included in a set of tourist spots. As an example, consider the case where there are "Rokuonji" and "Kiyomizudera" in the tourist spot group. At this time, the features of "Rokuonji" will be gold color, gold leaf, glow, etc., the features of "Kiyomizudera" are the stage, the womb inside, the panoramic view etc. Because both are temples existing in Kyoto, features related to Kyoto and temples do not appear as unique features. Next, consider the case where "the Tokyo Metropolitan Government Building Observatories" and "Rokuonji" exist within the tourist spot group. Features of "Rokuonji" at this time will be Kinkakuji, a temple, golden color, Kyoto etc. Features of "the Tokyo Metropolitan Government Building Observatories" will be perspectives, night view, Shinjuku etc. If the categories of tourist spots are largely different, features as categories will appear. Also, it can show the features of the spot itself. In this research, when a certain spot compares with other spots in the set, we focus on the relative features that make it possible to clarify the features of each spot.

The spot differential vector is defined as formula 1. Is the value obtained by subtracting the average value of the spot vectors of the spots of the spot group excluding the spot for which the spot differential vector is found. $spot_{set} = \{s_1, s_2, \ldots, s_i, \ldots, s_n\}1$ is a familiar spot set or an unfamiliar spot set. s_i is a tourist spot in the set.

$$v_i = s_i - average(spot_{set} - s_i) \tag{1}$$

C. Determination of explainable spot

From the feature difference vector v_i of the familiar spot and the feature difference vector v_j of the unfamiliar spot,

[1]https://github.com/neologd/mecab-ipadic-neologd/

[2]https://radimrehurek.com/gensim/models/doc2vec.html

[3]https://www.jalan.net/kankou/

the relative feature similarity between the familiar spot and the unfamiliar spot (Fig. 2). For the similarity calculation, use the cosine scale (formula 2).

$$cos(v_i, v_j) = \frac{v_{i1}v_{j1} + v_{i2}v_{j2} + \cdots + v_{in}v_{jn}}{\sqrt{v_{i1}^2 + \cdots + v_{in}^2} \times \sqrt{v_{j1}^2 + \cdots + v_{jn}^2}} \quad (2)$$

A correlation between the familiar spot having similarity of each feature vector of the familiar spot and each feature vector in the unfamiliar area of 0.125 or more and the highest similarity and the unfamiliar spot is performed. In addition, there are two ways to establish an association between a familiar spot and an unfamiliar spot.

1) how to relate to unfamiliar spots based on already familiar spots
2) how to relate to already familiar spots based on unfamiliar spots

In the method 1, if the spot in the unfamiliar area holds a plurality of features when using the familiar spot as the base, there are cases where the spot is associated with the same unfamiliar spot. In method 2, method 2 is used as it is possible to extract features of each spot from the familiar spot set based on the unfamiliar spot and associate with the unfamiliar spot. In addition, in this research, it is considered reasonable to base on unfamiliar spots to explain unfamiliar spots.

D. Extraction of explainable words for role

All tourist spots review words by using morphological analyzer "mecab-ipadic-NEologd". However, words obtained by using these words contain words that do not hold Japanese, and it is necessary to delete these noises. Specifically, delete particles, auxiliary verbs, rentaishi, symbols, stopwords.

Since the explanation information of the fami spot and the unfamiliar spot associated in section III-C is presented to the user in word format, a review set of a certain tourist spot is assumed to be a document i and a spot where the word j for i appears When the number of occurrences of the set is $TF_{i,j}$, the word j is the number of documents in the spot set is DF_j, and the total number of spots in the spot set is $|D|$ The feature quantity of a word in a spot is defined by the formula 3.

$$word_{i,j} = TF_{i,j} \times IDF_j \quad (3)$$

$$IDF_j = log(\frac{|D|}{DF_j}) \quad (4)$$

In this method, for familiar spots, the user inputs plurality of spots. By considering all reviews of each spot as one document at a time and by considering all reviews of the other spots as documents, the TFIDF value is calculated by the formula 3, 4, and use it as the feature words for each spot in the unfamiliar area.

Regarding the unfamiliar area, the user designates an area and inputs it. By considering all reviews of each spot in the area as one document and considering all reviews of the other spots as a document, the TFIDF value is calculated by the formula 3, 4, and use it as the feature words for each spot in the unfamiliar area.

Fig. 3. Output interface

The explanation information on the associated familiar spots and unfamiliar spots associated with each other is determined by using harmonic averages according to feature words of each spot obtained by TFIDF. The harmonic mean is the reciprocal of the arithmetic mean of the reciprocal. Extracts commonly appearing words in the review document of the familiar spot and the review document of the unfamiliar spot. The score of the extracted word is defined by the formula 5. $word_{familiar}$ and $word_{unfamiliar}$ indicate the TFIDF value of the familiar spot and the TFIDF value of the unfamiliar spot, respectively. When the value of the word score is large, the TFIDF value of each of the familiar spot and the unfamiliar spot is large, that is, the word has high importance in each document. Therefore, the top ten words of the word score are presented to the user as explanation information (Fig. 3).

$$score = \frac{2 \cdot word_{familiar} \cdot word_{unfamiliar}}{word_{familiar} \cdot word_{unfamiliar}} \quad (5)$$

E. Example of explained unfamiliar spots

Table I is an example of a spot that a user has familiar spots and unfamiliar spots.

Unfamiliar spots are five spots randomly selected from within Tokyo. Table II shows the results of explaining the explanatory words using the proposed method in Section **??**.

Focusing on the feature of the park, it is thought that the spot closest to the park in the unfamiliar spot group is "Shinjuku Gyoen". In the set of familiar spots there are two parks, "Odawara-jo Park" and "Nara Park". "Odawara-jo Park" has a lot of descriptions about flowers and play equipments, and there are many descriptions for deers and grass at "Nara Park". Because "Shinjuku Gyoen" has a lot of descriptions about flowers and play equipments, it seems to be related to "Odawara-jo Park".

"Mishima Skywalk" has a view in the set of familiar spots, and it can be considered that the feature of the highest is the strongest. There are two of "Tokyo Skytree" and "Tokyo Tower Main Deck" that have good views with a high view in the unfamiliar spot group. "Tokyo Skytree" is thought to be "Mishima Skywalk" to its higher level, but "Mount Fuji" is included when I look at the explanation information. The height of the two spots is highlighted by the word "Mount Fuji". The proposed method can show the feature of each set of spots.

TABLE I
FAMILIAR SPOT GROUP AND UNFAMILIAR SPOT GROUP

Familiar Spot Name	Unfamiliar Spot Name
Sensoji Temple	Tokyo Disneyland (R)
Odawara-jo Park	Shinjuku Gyoen
Fushimiinari-taisha Shrine	Tokyo Skytree
Nara Park	Tokyo Tower Main Deck
Mishima Skywalk	Meiji Jingu

IV. EVALUATION EXPERIMENT

A. Experiment contents

We compare absolute features and methods to present explanatory information by relative features of the proposed method. In addition, in the case of using relative features, we compare the method of calculating word scores using harmonic mean and the method of calculating word score using arithmetic mean.

We collected 24 subjects using CrowdWorks[4], a crowdsourcing service. We presented presentation information on unfamiliar spots by selecting subjects' familiar spots using tourist spots acquired by Jalan taking place. The patterns of explanatory information of absolute feature and relative features are as follows.

- A Absolute feature (category, duration time, season)
- B Absolute feature (feature vector)
- C Relative features (differential vector, harmonic mean)
- D Relative features (differential vector, arithmetic mean)

The explanation information A is narrowing-down information used for searching spots on the sightseeing spots search site. Three examples of narrowing down information are as follows.

- category: Shrine / Temple, Tourist facilities / Tourist tours etc.
- duration time: less than 1 hour, 1˜2 hour etc.
- season: 1˜12 month, spring, summer, autumn, winnter

First, using the familiar spot, we gradually narrow down the information in order of whether the categories with unfamiliar spot match, whether it matches the duration time or not, and whether or not it matches the season, and the familiar and the unfamiliar spot. Next, if there are multiple unfamiliar spots after squeezing, use the unfamiliar spot with the most review number. Finally, we extract the role words for explanation using section III-D and present them to the subjects. The explanation information B is the feature of each spot using the feature vector created in section III-A. The explanation information C is the proposed method. The explanation information D, explanation information on the familiar spot and the unfamiliar spot associated with each other is determined by using harmonic averages according to feature words of each spot obtained by TFIDF. Extracts commonly appearing words in the review document of the familiar spot and the review document of the unfamiliar spot. In addition, it is necessary for the extracted word to have an average value of the TFIDF values of the respective spots. The absolute value of the difference between the TFIDF value of the familiar spot word and the TFIDF value of the unfamiliar spot word is calculated as the word score and ten words whose word score is the closest to 0 are posted on the subject as explanation information.

First, the subjects have familiar spot, favorite spot and enter between 4 to 10. Have the input spots be selected from the search candidates. For example,Shinjuku Gyoen—Shinjuku, Kiyomizudera—Kyoto etc. Next, the subjects never went on a trip etc and entered prefectures / areas that we would like to visit. Processing was carried out in the order of A to D of the pattern of explanation information, and the unfamiliar spot name, keyword, and familiar spot name were presented to the user, and one of the following 5 evaluations was selected.

1) No keyword
2) There is a relationship between the two spots in the first place, the relationship became clear by the keyword.
3) To the relationship of the two spots noticed for the first time by keyword.
4) There is a relationship between the two spots, but the keyword does not represent the relation.
5) There is no relationship between the two spots.

B. Result

Table III shows the number of data of each experimental result of explanation information A to D of Evaluations 1 to 5. In the evaluation experiment, the total of usable data is 394. The explanation information A has the smallest number of familiar spots associated with unfamiliar spots. The explanation information B has the largest number of familiar spots related to unfamiliar spots. The explanation information C and explanation information D, the association method between the unfamiliar spot and the familiar spot is the same, so the numbers are the same.

Table IV shows the ratio of the number of data of the experiment results as the evaluation 1 to 5 in the explanation information A to D. The explanatory information A presented to subjects, the unfamiliar spot and the familiar spot were originally related, and further clarified by presenting keywords. The explanatory information D thought that there was no relevance to the unfamiliar spot and the familiar spot, but since it was noticed for the first time by presenting the keyword to the subject, it is related to the proposed method of this research. In explanation information C and explanation information D, there are many proportions in which the unfamiliar spot presented to the subject and the familiar spot are not related in the first place. In the four explanatory information patterns, only the explanatory information D has no keyword to present to the subject. Therefore, it can be said that in many cases it is possible to present keywords to subjects by using harmonic means. In addition, it can be shown that evaluation 1, evaluation 4 and evaluation 5 mean that explanation information is meaningless. Therefore, it can be said that explanation information D does not make the most sense.

From evaluation 1 and evaluation 2, the best case is to use categories that are unfamiliar spots presented to subjects and familiar spots in the first place. However, since the number of relevant spots is limited to categories, there are also few numbers that can be presented to subjects. In addition, it can not be said that unexpectedness can not be obtained because spot information of another category can not be presented to subjects. The second is to use the feature

[4]https://crowdworks.jp/

TABLE II
EXPLANATION INFORMATION

Unfamiliar Spot	Familiar Spot	Explanation Information
Shinjuku Gyoen	Odawara-jo Park	flower viewing, bloom, inside the park, cherry-blossoms, carefree, care, nature, play equipment, azalea
Tokyo Skytree	Mishima Skywalk	mount fuji, tremor, high fear, trembling, ceiling, magnificent view, elevator, panorama, observation deck, rising

TABLE III
STATISTICS ON THE NUMBER OF DATA OF EXPERIMENT RESULTS

Evaluation	Explanation information A	Explanation information B	Explanation information C	Explanation information D	Total
1	0	0	0	4	4
2	19	44	32	26	121
3	20	62	53	56	191
4	1	3	3	3	10
5	6	21	21	20	68
Total	46	130	109	109	394

TABLE IV
PERCENTAGE OF EVALUATION IN EXPLANATION INFORMATION

Evaluation	Explanation information A	Explanation information B	Explanation information C	Explanation information D
1	0.00%	0.00%	0.00%	3.67%
2	41.30%	33.85%	29.36%	23.85%
3	43.48%	47.69%	48.62%	51.38%
4	2.17%	2.31%	2.75%	2.75%
5	13.04%	16.15%	19.27%	18.35%

vector, the third to combine the difference vector and the harmonic mean, the combination which is not the best is the combination of the difference vector of the explanation information D and the arithmetic mean. Although the number of spots with relevance between explanation information C and explanation information D is the same, it can be said that the role of understanding support of keywords presented to subjects is reduced by calculating word scores using arithmetic mean.

Evaluation 2 is the combination of the difference vector and arithmetic mean, the combination of the difference vector and the harmonic mean is the second best, the third is the case where the feature vector is used, and the case where the category is not the best is used. Therefore, it can be said that a combination of a difference vector between the feature vector of the explanation information B and the explanation information C and a harmonic mean can show a good result. In addition, by using the difference vector, subjects have unexpectedness, and it is possible to present unfamiliar spots irrespective of categories.

For explanation information B and explanation information C, the case where the category of the familiar spot inputted by the examinee is different is similar to the case where the categories of the familiar spots input by the subject are different, the ratio of the evaluation of the evaluation 2 and the evaluation 3 is the table V. Using explanation information C, which is the proposed method, subjects can present meaningful keywords without relation to a certain spot that the subject has familiar visited. By using the difference vector, it can be said that the characteristics of each spot can be found over the category. In the case where the genres of the familiar visited spots are similar, the explanation information B is better than the case.

V. CONCLUSIONS AND FUTURE WORK

In this research, we focused on the difficulty of understanding the sightseeing spots searched by using the sightseeing search information in ranking, recommendation information, categories etc, if the sights where the user wants to visit have not been decided. In order to support understanding of unfamiliar spots, we proposed an explanatory method to support understanding by fitting the characteristics of spots that users have already visited to unfamiliar spots.

In the evaluation experiment, comparison was made using four explanatory information patterns. As a result, in the case of using categories, the number of familiar spots associated with unfamiliar spots is the smallest. In the case of using the difference vector and arithmetic mean, the role of supporting the understanding of keywords is the least. By using the difference vector and harmonic mean, the characteristics of each spot can be obtained. In addition, we confirmed that it was possible to correlate unexpected unfamiliar spots with already familiar spots, and that there is a possibility that interest and attention can be drawn to tourist spots that users do not know.

As future tasks, we analyze the relevance between keywords presented to users obtained at the time of experiment, categories of unfamiliar spots and familiar spots. We also plan to evaluate the effectiveness and relevance of each keyword presented to the user.

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TABLE V
WHEN THE CATEGORIES OF THE FAMILIAR SPOTS ARE DIFFERENT OR PERCENTAGE OF EVALUATION WHEN SIMILAR

	When the familiar spots are different	When the familiar spots are similar
Explanation information B & Evaluation 1	56.82%	43.18%
Explanation information C & Evaluation 1	71.87%	28.13%
Explanation information B & Evaluation 2	51.61%	48.39%
Explanation information C & Evaluation 2	52.83%	47.170%

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